

THE WEATHER AND CIRCULATION OF JULY 1969

A Predominantly Wet Month, Cool in the North and Warm in the South

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1. MEAN CIRCULATION

The large amplitude circulation of June (Wagner, 1969) over North America was replaced in July by zonal flow (figs. 1, 2). The greatest month-to-month change occurred in the polar region where an unusually deep Low was observed and where mean 700-mb heights fell as much as 200 m. Heights also fell sharply over western Canada as the strong ridge in June collapsed in July. The deep trough in eastern North America, which was responsible for the cool conditions of June over much of the United States, weakened in July as it progressed to the western Atlantic. A weak ridge developed over Northeast Canada between the Atlantic trough and the trough associated with the polar Low.

Over the United States and southern Canada the average July circulation was very similar to the normal, with troughs along both coasts and a ridge over the Northern and Central Plains (fig. 1). The near normality of the circulation is also indicated by the rather small departures from normal of 700-mb height (fig. 2).

A deep Low near Iceland was accompanied by greater than normal storminess across the North Atlantic. Warm and dry weather prevailed over much of Europe which was dominated by a strong upper ridge. Sea-level pressures here averaged well above the normal, as much as 7 mb in some places. An "omega" circulation pattern prevailed over Asia with the ridge as the dominant feature (fig. 1). The area of positive height anomaly with this ridge encompassed the high latitudes on the Asiatic side of the Pole (fig. 2). Zonal flow prevailed across the Pacific where mean troughs were rather closely spaced and where the two anticyclones were both stronger than normal.

The zonal flow over most of the Northern Hemisphere is also suggested by the mean isotachs for July, shown in figure 3. Note that the principal 700-mb jet axis departed very little from the normal in most areas. Strongest winds were observed over the Atlantic where speeds of 15 m sec⁻¹ were twice the July normal. The jet axis around the polar Low also had wind speeds twice the normal.

Significant changes in circulation occurred just after midmonth, as shown in figure 4 by the change in 700-mb height from the first half to the last half of July. The polar Low deepened and expanded its cyclonic circulation to Alaska, bringing cooler and wetter conditions to much of that area. As blocking increased in central and eastern Canada, a deep, slowly moving mean trough developed in the East, bringing heavy rains to the Atlantic Coast States. Areas of greatest height change were in the Atlantic (−140 m), where storminess increased during the latter

half of July, and in the Aleutians (+150 m), where cyclonic activity was weaker.

2. TEMPERATURE

Average temperatures for July were below normal in the Northern States while to the south they were above normal (fig. 5). The Northern Plains and New England had the greatest negative departures, with Concord, N.H. (−4.2° F), reporting its coolest July in a record dating to 1871. At Boston, Mass., the average daily maximum temperature was the lowest recorded in July since 1915. Billings, Mont. (−5.4° F), had its third coolest July in 35 yr of airport records. By contrast, Greensboro, N.C., Waco, Tex., and Pueblo, Colo., had their hottest months of record.

The observed temperature pattern was consistent with the small amplitude flow over North America (fig. 1), which confined cool Pacific air masses primarily to the North and limited their southward movement. In addition, the anomalous flow at 700 mb was westerly across the North and easterly in the South (fig. 2).

Hot, humid weather was most persistent in the Southern Plains beneath the mean upper anticyclone and where 700-mb height departures from normal were greatest. Temperatures of 100°F or more were common in the Lower Plains during the first half of the month, extending briefly into portions of the Upper Plains on the 11th and 12th. At Tulsa, Okla., 100°F temperatures were reached or exceeded on 10 consecutive days, from the 9th to the 18th.

The Far Southwest was also hotter than it usually is in July. On the 31st some stations in Arizona, California, and Nevada recorded maximum temperatures from 112° to 117°F. At Red Bluff, Calif., there were 7 consecutive days of 105°F or higher for only the third time since 1877.

Temperatures gradually lowered to below normal in the Southeast at the end of the month, in response to amplification of the circulation over the United States where 700-mb heights lowered in the East and increased in the West (fig. 3).

3. PRECIPITATION

Much of the Nation had rainfall totals that were near to well above the July normal (fig. 6). It was especially wet in the Northern and Central Plains States, Lower Lakes Region, Middle Atlantic States, and along portions of the Gulf Coast. In some places amounts were twice to as much as three times normal, with numerous stations reporting record or near-record totals (table 1). Heaviest precipitation was reported at Tallahassee, Fla.,

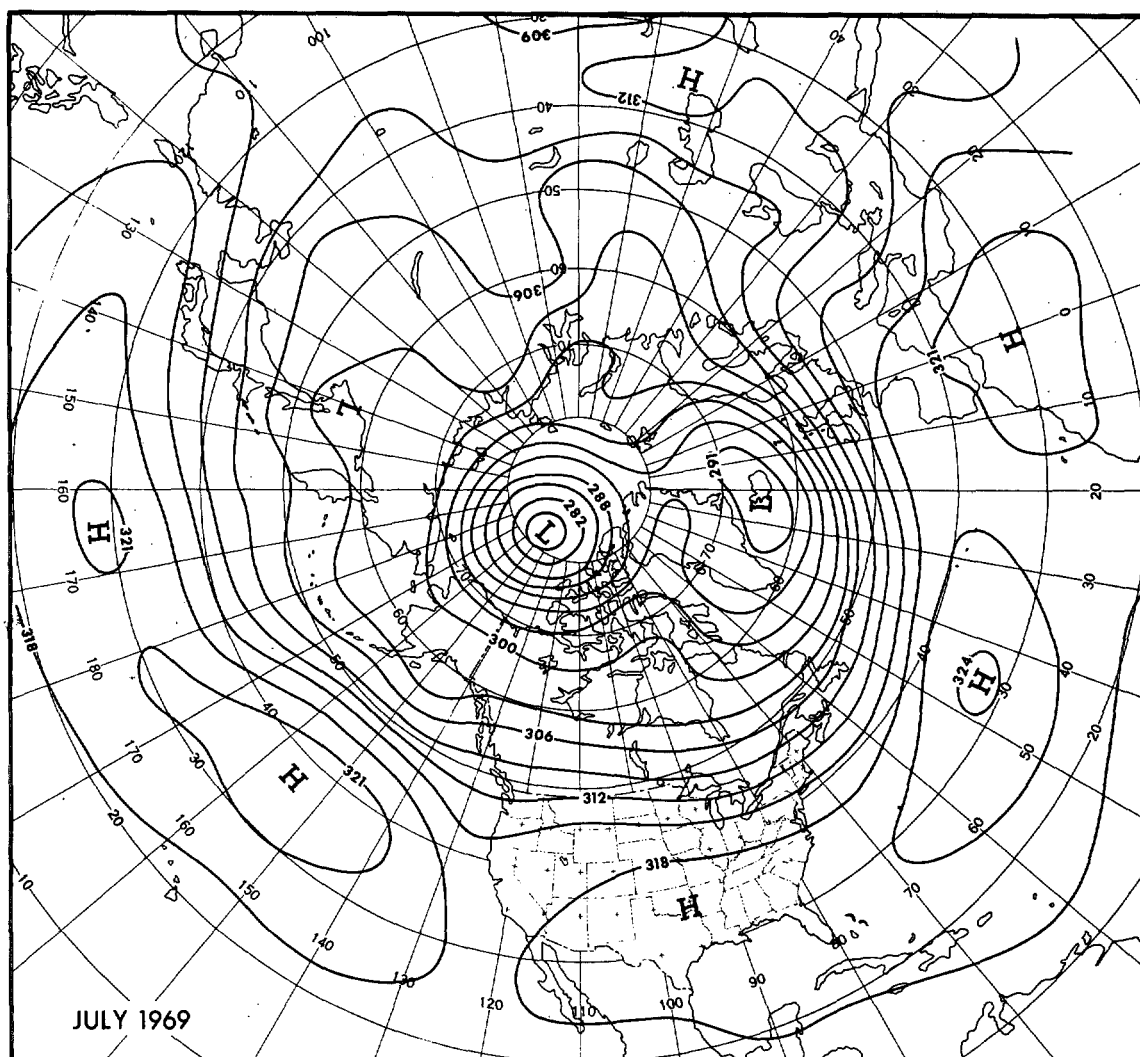


FIGURE 1.—Mean 700-mb contours (decameters) for July 1969.

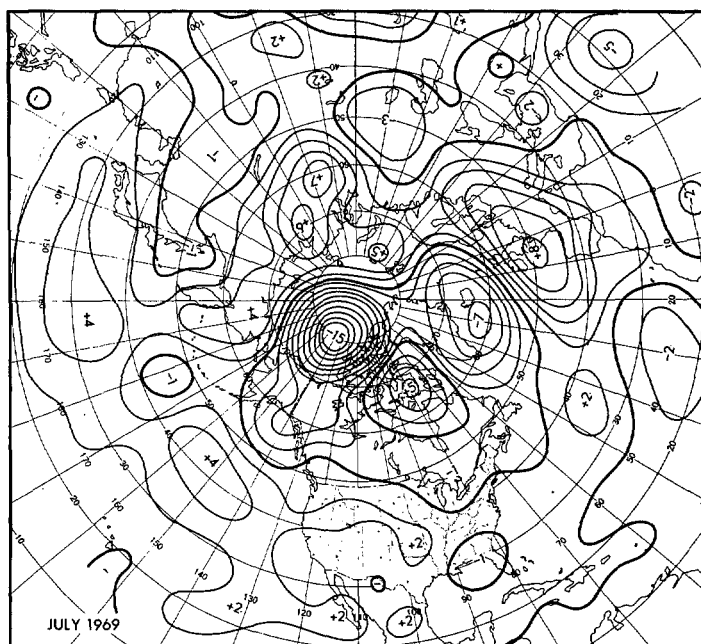


FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for July 1969.

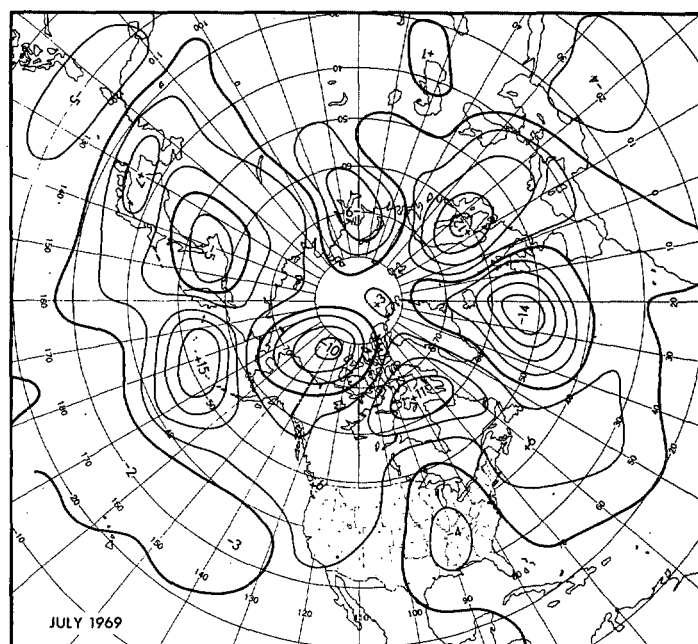


FIGURE 3.—Change of 700-mb height (decameters) from July 1-15 to July 16-31, 1969.

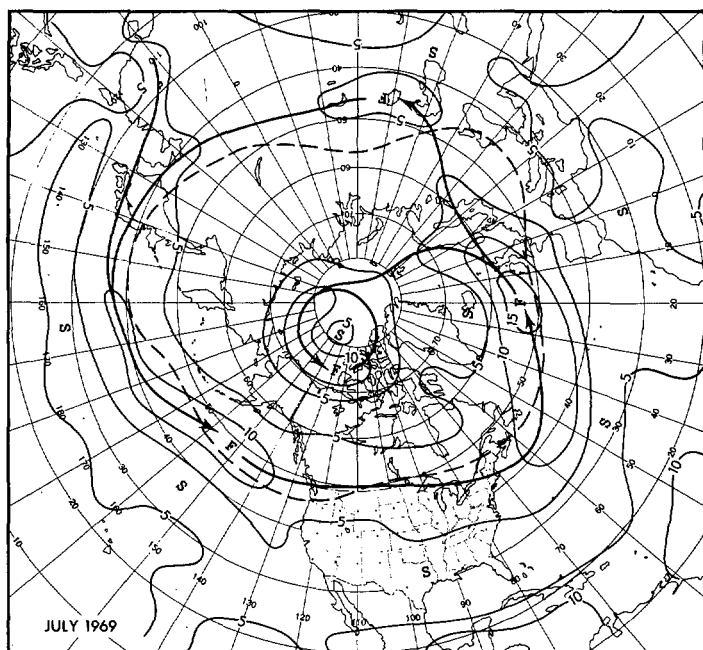


FIGURE 4.—Mean 700-mb isotachs (meters per second) for July 1969. Solid arrows indicate axes of maximum wind speed; dashed line indicates the normal.

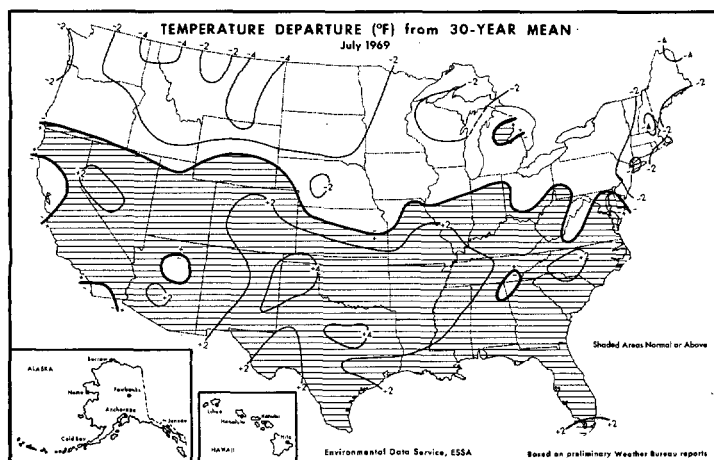


FIGURE 5.—Departure from normal of average surface temperature (°F) for July 1969 (from Environmental Data Service, 1969).

where 18.83 in. fell with measurable amounts recorded on all but 8 days. Locally dry areas were also observed, particularly in the Far West, Wyoming, and Texas. Oklahoma was very dry most of the month, with Tulsa receiving only 0.05 in. between June 26 and July 30, but 1.03 in. on July 31.

Most of the precipitation in northern areas fell as widespread showers associated with the frequent passage of cold fronts. Some of these fronts later became stationary across the middle of the Nation, producing additional convective activity. More local showers fell in the hot, humid air in the south. Numerous areas had heavy thunderstorms that caused local flooding. More extensive flooding occurred along the middle Mississippi River at midmonth, the result of heavy rains early in July.

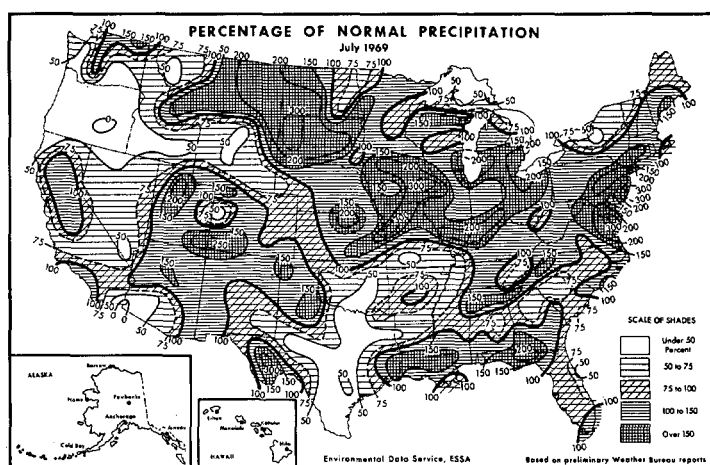


FIGURE 6.—Percentage of normal precipitation for July 1969 (from Environmental Data Service, 1969).

TABLE 1.—Stations reporting record or near-record total monthly precipitation during July 1969

Station	Total precipitation (inches)	Remarks
Norfolk, Va.....	12.70	2d wettest July of record (1871)
Richmond, Va.....	13.90	3d wettest month of record
Harrisonburg, Va.....	13.06	Wettest July of record (1886)
Hartford, Conn.....	5.79	2d wettest July in past 23 yr
Allentown, Pa.....	10.42	Wettest July of record (1912)
Avoca, Pa.....	6.81	Wettest July since 1948
Cleveland, Ohio.....	6.47	4th wettest July of record
Youngstown, Ohio.....	5.79	4th wettest July of record
Grand Rapids, Mich.....	6.42	4th wettest July of record
Huron, S. Dak.....	4.52	2d wettest July since 1920
Bismarck, N. Dak.....	5.24	2d wettest July since 1875
Millford, Utah.....	1.36	2d wettest July in last 32 yr
Los Angeles, Calif., International Airport	0.15	Wettest July of record
Juneau, Alaska.....	7.88	Wettest July of record
Cheyenne, Wyo.....	0.58	2d driest July of record
Corpus Christi, Tex.....	0.03	4th driest July since 1900

Violent thunderstorms swept across Lake Erie and vicinity to extreme northern West Virginia on the 4th. Some areas received 4 to 10 in. of rain (table 2), and winds over Lake Erie were as high as 100 mi hr⁻¹. Thirty-three deaths were reported from these storms, with property damage of several million dollars.

A large part of the precipitation in the East occurred with heavy thunderstorms during the last half of the month. These storms resulted from the deepening trough, a series of slow-moving frontal systems, and a persistent southerly flow of tropical air. Heavy rains of more than 9 in. in the Potomac Region (fig. 7) were very beneficial as they ended a long dry period and threatened water crisis. At Washington, D.C. (National Airport), all but 0.38 in. of the monthly total of 9.44 in. fell from the 20th to the 28th. Over 4 in. fell here in 2 hr on the 22d, with the rate of fall of 1.03 in. in 10 min, 2.53 in. in 30 min, and 3.29 in. in 60 min being an all-time record. As much as 7 in. fell in the Virginia suburbs where serious flooding caused damages estimated at \$3 million. The same series of storms drenched Leonardtown, Md., with 12.44 in. on the 22d-23d. Some stations in the East reporting unusually heavy

TABLE 2.—Stations in the eastern one-third of the Nation recording unusually heavy precipitation in a 24-hr period in July 1969

Station	Precipitation (inches)	Date
Evansville, Ind.	3.36	20-21
Indianapolis, Ind.	4.00	20
Mansfield, Ohio	5.06	4-5
Mount Washington, N.H.	*7.26	29-30
Allentown, Pa.	4.54	27-28
Atlantic City, N.J.	4.85	20-21
Washington, D.C.	4.40	22-23
Richmond, Va.	5.73	22-23
Norfolk, Va.	5.64	26-27
Wilmington, N.C.	3.27	30-31
Tallahassee, Fla.	4.68	21-22

*All-time record

precipitation in a 24-hr period, most of which fell in the last one-third of July, are listed in table 2.

4. TROPICAL STORMS

The first tropical storm of the season was reported on July 28 in the Atlantic, near 12.0° N., 41.0° W. Named Anna, this storm apparently had its origin in a depression that moved off the African coast on the 23d. Anna never quite reached hurricane status and became a very small system that moved rapidly northward off the Atlantic coast, passing about 200 mi east of Cape Hatteras, N.C., on August 2 before turning out to sea. This storm was steered by the circulation around a stronger than normal 5-day mean subtropical High near 35° N., 55° W.

Three tropical storms, Ava, Bernice, and Claudia, were observed in the eastern Pacific during July. All moved west-northwestward in the subtropical easterlies; none affected any land areas and only Bernice attained hurricane status.

Three tropical storms were also observed in the western Pacific. Winnie remained a tropical storm while Tess and Viola reached typhoon intensity. All remained in the easterlies with Viola by far the largest and most severe. This storm caused heavy damage in the Philippines on July 27 and brushed Taiwan with 130-kt winds before moving into China.

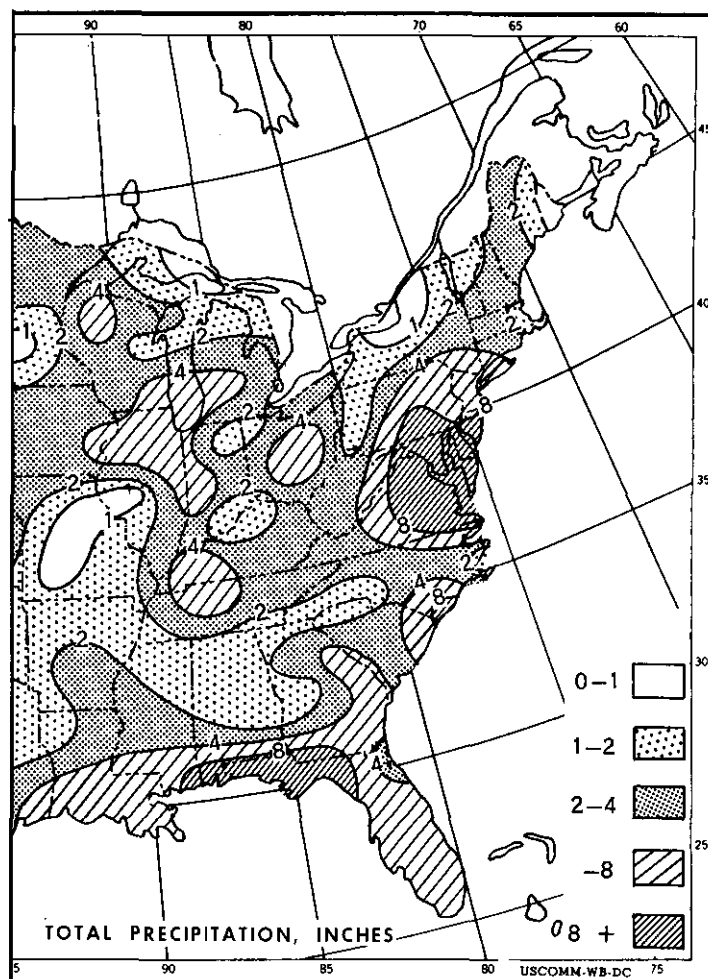


FIGURE 7.—Total precipitation (inches, approximate) for July 16-31, 1969.

REFERENCES

- Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, Vol. 56, No. 32, Aug. 11, 1969.
 Wagner, A. J., "The Weather and Circulation of June 1969—A Predominantly Cool and Wet Month," *Monthly Weather Review*, Vol. 97, No. 9, Sept. 1969, pp. 684-690.

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